Monitoring Saltation Activity

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We use an instrument called SENSIT[1] to monitor saltation activity. Saltation activity is detected by means of a piezoelectric crystal that responds to the impact of saltating grains and outputs a pulse signal proportional to the number of such impacts (Stockton & Gillette, 1990). We often sample the signal from SENSIT each second so that the output represents the number of particles that impact the crystal each second. We use the signal from SENSIT as a relative measure of saltation activity or to simply detect the presence of saltating grains. Others have attempted to interpret the signal as a measure of mass flux or momentum (Gillette & Stockton, 1986).

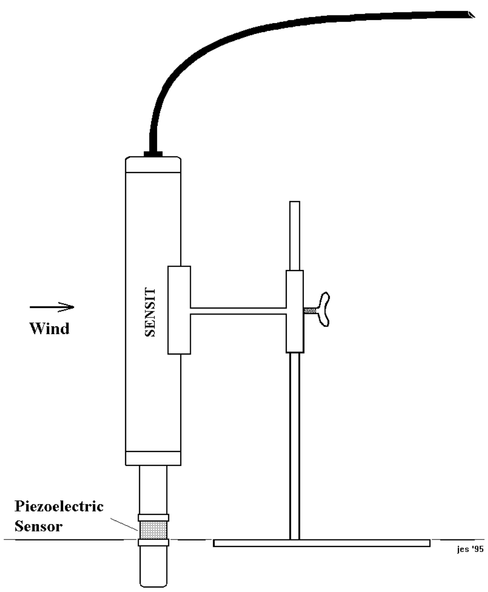

Figure 1. SENSIT mounted above ground.

[1]Names are necessary to report factually on available data; however, the USDA neither guarantees nor warrants the standard of the product, and the use of the name by USDA implies no approval of the product to the exclusion of others that may also be suitable.

As shown in Figs. 1 and 2, SENSIT can be mounted above ground or it can be buried as shown in Fig. 2. In either case, the lower edge of the sensing element is set flush with the eroding surface and the cylindrical sensing element extends from the surface to a height of 13 mm. The diameter of the sensing element is 25 mm.

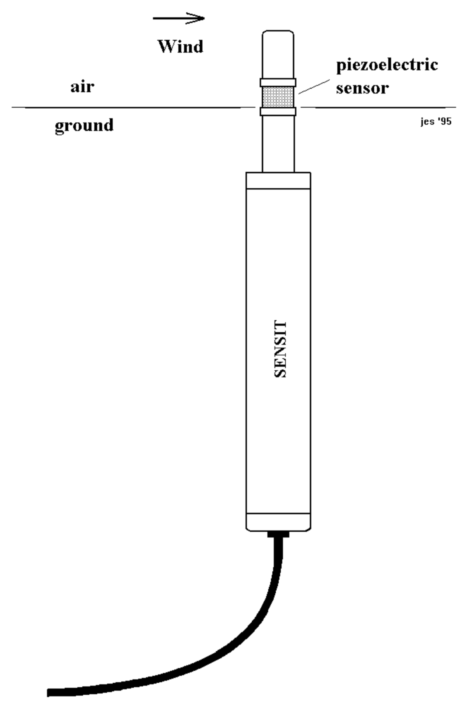

Figure 2. SENSIT mounted below ground.

As explained in Stockton & Gillette (1990), the sensitivity of the piezoelectric crystal was purposely adjusted so that it responds exclusively to the impact of saltating grains. This adjustment reduces the possibility of false readings from wind vibration or electrostatic noise. The instrument also does not respond to the movement of fine dust grains since fine particles normally follow the airflow around the sensing element and thereby fail to impact. Even if a fine dust speck were to impact the piezoelectric crystal, the momentum transfer would be too low to trigger a pulse.

We recently completed a series of laboratory tests of SENSIT's sensitivity by dropping glass beads from a fixed height onto the sensing element. These tests revealed that the piezoelectric crystal does not respond to particles with momentum less than about $5x10^{-8}$ N s.

Particle momentum is the product of particle mass and velocity, so a small particle moving quickly can have the same momentum as a large particle moving slowly. The minimum velocity of a given diameter sand grain (particle density of 2650 kg/m^3) that yields a particle momentum of $5x10^{-8}$ N s is calculated in Table 1. The calculations suggest that it is unlikely that SENSIT responds to particles with diameter less than about 100 μm since it is nearly impossible for such grains to attain a speed of 36 m/s during a typical wind erosion event. However, the sensor will most likely respond to particles larger than 200 μm since the required particle speed is generally less than typical wind speeds associated with dust storms. Because SENSIT only responds to impacts of larger grains, it acts primarily as a saltation sensor.

Since dust can be generated far upwind and transported vast distances, the presence of dust is not a reliable indicator of erosion activity at a single point of measurement. The presence of saltation activity, however, clearly indicates that erosion is occurring at the point of measurement. Thus, the fact that SENSIT ignores the movement of fine particles is a positive feature since the selective signal from SENSIT is a clear indication of the level of saltation activity at a given point within the field.

Table 1. Velocity of particle with diameter D to achieve minimum detectable momentum value of $5x10^{-8}$ N s.

D (μm)	Mass (kg)	Velocity. ($m\ s^{-1}$)
100	1.39E-09	36.04
150	4.68E-09	10.68
200	1.11E-08	4.50
300	3.75E-08	1.33
400	8.88E-08	0.56
500	1.73E-07	0.29
600	3.00E-07	0.17
700	4.76E-07	0.11
800	7.10E-07	0.07
900	1.01E-06	0.05
1000	1.39E-06	0.04

References

Gillette, D. A. & P. H. Stockton. 1986. Mass, Momentum and Kinetic Energy Fluxes of Saltating Particles. **Aeolian Geomorphology**, ed. by W. G. Nickling, Allen and Unwin, Boston, pp.35-56.

Stockton, P. & D.A. Gillette. 1990. Field measurements of the sheltering effect of vegetation on erodible land surfaces. *Land Degradation & Rehabilitation* **2**:77-85.